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Patent claims

1. A cutting tool having a tool shank (10) and a cutting head (12) made of different materials which are integrally connected to one another via a joining layer (18') made of ductile brazing material at joining surfaces (14, 16) facing one another, powder particles (31) made of a temperature-resistant material having a lower coefficient of thermal expansion than the brazing material (30) being embedded in the joining layer (18'), characterized in that the joining layer (18') has a different coefficient of thermal expansion over its layer thickness, the coefficient of thermal expansion being lower on the side (32) of the cutting head (12) than on the side (34) of the tool shank (10).

2. The cutting tool as claimed in claim 1, characterized in that the density of the powder particles (31) varies over the thickness of the joining layer (18').

3. The cutting tool as claimed in claim 1 or 2, characterized in that the density of the powder particles (31) within the joining layer (18') is higher on the side (32) of the cutting head (12) than on the side (34) of the tool shank (10).

4. The cutting tool as claimed in one of claims 1 to 3, characterized in that the tool shank (10) is made of steel, preferably of tool steel.

5. The cutting tool as claimed in claim 4, characterized in that the tool shank is made of a case-hardened steel having a phase transformation point within a range of 480 to 650°C.

6. The cutting tool as claimed in claim 5, characterized in that the tool shank is made of a case-hardened steel having a chrome content of less than 2%.

7. The cutting tool as claimed in either of claims 5 and 6, characterized in that the tool shank is made of a 16MnCr5 steel.

8. The cutting tool as claimed in one of claims 5 to 7, characterized in that the case-hardened steel is carburized or nitrided at least on the outer surface of the tool shank.

9. The cutting tool as claimed in one of claims 1 to 8, characterized in that the cutting head is made of a material of the group comprising cemented carbide, cermet, ceramic or PCD.

10. The cutting tool as claimed in one of claims 1 to 9, characterized in that the joining surfaces (14, 16), facing one another, of the tool shank (10) and the cutting head (12) are preferably curved so as to be complementary to one another.

11. The cutting tool as claimed in one of claims 1 to 10, characterized in that the joining surface (14) of the cutting head (12) is convexly curved.

12. The cutting tool as claimed in one of claims 1 to 11, characterized in that the joining surface (14) of the tool shank (10) is concavely curved.

13. The cutting tool as claimed in one of claims 1 to 12, characterized in that the tool shank (10) has at least one preferably helically wound flute (26), which passes through the joining layer (18′) in the direction of the cutting head (12).

14. The cutting tool as claimed in one of claims 1 to 13, characterized in that the tool shank (10) has at least one preferably helically wound functional passage (28), which passes through the joining layer (18') in the direction of the cutting head (12).

15. The cutting tool as claimed in one of claims 1 to 14, characterized in that the joining layer (18') contains a brazing material of the group comprising copper, silver, cobalt or their alloys.

16. The cutting tool as claimed in one of claims 1 to 15, characterized in that the powder particles (31) embedded in the brazing material (30) of the joining layer (18') are made of a material of the group comprising tungsten, molybdenum, iron, cobalt, nickel or their carbides.

17. The cutting tool as claimed in one of claims 1 to 16, characterized in that the thickness of the joining layer (18') corresponds to 10 to 1000 times the diameter of the powder particles (31).

18. The cutting tool as claimed in one of claims 1 to 17, characterized in that the thickness of the joining layer (18') is 0.1 to 2 mm.

19. A method of producing a cutting tool in which a preformed tool shank (10) and a cutting head (12) preferably preformed as a blank are integrally connected to one another by fusing and subsequently cooling a brazing filler (18) in the region of a joining gap while forming a joining layer (18'), characterized in that the brazing filler in the form of at least two brazing disks (18) made of brazing material (30) containing embedded temperature-resistant

powder particles (31) and having a different particle density is inserted into the joining gap and in that the brazing disks are fused to one another there.

20. The method as claimed in claim 19, characterized by the following method steps:

a) the joining members consisting of tool shank (10) and cutting head (12) are heated to joining temperature;

b) the at least two brazing disks (18) are inserted into a joining gap between the joining members (10, 12) before, during or after the heating;

c) after the joining temperature is reached, the joining surfaces (14, 16), facing one another, of the joining members (10, 12) are wetted with fused brazing material (30);

d) after that, the joining members are cooled to room temperature while forming a composite part;

e) the composite part is then machined at room temperature and is brought to the same diameter in the joining region, for example by grinding;

f) the composite part prepared in this way is heated again to a coating temperature below the joining temperature and held for a time at this temperature and in the process is preferably coated with a coating material;

g) after that, the composite part is cooled to room temperature while forming the finished part.

21. The method as claimed in claim 19 or 12, characterized in that the axial density profile of the powder particles (31) in the brazing material is selected in such a way that an essentially stress-free joining zone is formed in the finished part.

22. The method as claimed in one of claims 19 to 21, characterized in that the structure of the tool shank (10) made of carbon steel or a surface-carburized case-hardened steel is hardened during the rapid cooling of the joining members and is annealed and stress-relieved during the subsequent tempering and/or coating process.

23. The method as claimed in one of claims 19 to 22, characterized in that the brazing disks (18), in the solid state before the heating of the joining members (10, 12), are connected to one of the joining members, preferably slipped onto or sintered in place on said joining member.

24. A brazing disk made of a ductile brazing material in which powder particles made of a temperature-resistant material having a lower coefficient of thermal expansion than the brazing material are embedded, characterized in that the density of the powder particles (31) varies over the disk thickness.

25. The brazing disk as claimed in claim 24, characterized in that the density of the powder particles varies over the disk radius.

26. The brazing disk as claimed in claim 24 or 25, characterized in that it is designed as a three-dimensional shaped piece which has a functional structure formed by holes (42', 44), recesses (42) or grooves.

27. A brazing disk made of a ductile brazing material in which powder particles made of a temperature-resistant material having a lower coefficient of thermal expansion than the brazing material are embedded, characterized in that it is designed as a three-dimensional shaped piece which has a functional structure formed by holes (42', 44), recesses (42) or grooves.

28. The brazing disk as claimed in one of claims 24 to 27, characterized in that it contains a brazing material of the group comprising copper, silver, cobalt and their alloys.

29. The brazing disk as claimed in one of claims 24 to 28, characterized in that the powder particles (31) embedded in the brazing material (30) are made of a material of the group comprising tungsten, molybdenum, iron, cobalt, nickel or their carbides.

30. The brazing disk as claimed in one of claims 24 to 29, characterized in that it has a convex contour (36) which is interrupted by at least one concave marginal recess (38).

31. The brazing disk as claimed in claim 30, characterized in that two concave marginal recesses (38) arranged on sides opposite one another are provided.

32. The brazing disk as claimed in one of claims 24 to 31, characterized in that it has at least one central hole (44).

33. The brazing disk as claimed in one of claims 24 to 32, characterized in that it has two plane joining surfaces (32, 34) parallel to one another.

34. The brazing disk as claimed in one of claims 24 to 33, characterized in that its joining surfaces (32, 34) facing away from one another are convexly and/or concavely curved.

35. The brazing disk as claimed in one of claims 24 to 34, characterized in that its joining surfaces (32, 34) have a surface structure formed from prominences and/or depressions.